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Comments on the FCC White Paper:

Federal Communications Commission
Omnibus Broadband Initiative

A Broadband Network Cost Model:
A Basis for Public Funding Essential to Bringing Nationwide Interoperable Communications to America's First Responders

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Executive Summary

The March 2010 FCC National Broadband Plan (NBP) was completed and presented to Congress. A portion of this plan (Chapter 16) was devoted to broadband for the public safety community (Public Safety Broadband Network) for first responders and other public safety personnel. The FCC's recommendations included:

1) *"Creating an administrative system that ensures access to sufficient capacity on a day-to-day and emergency basis;*
2) *Ensuring there is a mechanism in place to promote interoperability and operability of the network; and*
3) *Establishing a funding mechanism to ensure the network is deployed throughout the United States and has necessary coverage, resiliency and redundancy."*

Prior to and after the NBP being presented to Congress, the public safety community as a whole expressed many reservations with this plan. These reservations included concerns about the amount of spectrum that was allocated solely for public safety broadband use based on the FCC's findings that public safety does not need more spectrum for day-to-day operations, the assertion that under this plan, the public safety community would have priority access to all of the spectrum licensed and operated by the 700-MHz commercial operators, and the FCC's projected funding requirements.

In subsequent speeches and presentations,[1] the FCC Chairman and staffers embarked on a campaign to 1) garner support from the public safety community, and 2) defend the recommendations made in the plan. The public safety community was and remains adamant that the NBP as presented does not address the needs of the public safety community for an interoperable nationwide broadband network.[2] It has requested that changes be made to the report and that the members of Congress introduce legislation to correct these deficiencies. Congress has responded with the introduction of H.R.5081[3] on April 20, 2010, and has sent this bill to committee for action.

The FCC's tenor when discussing the NBP report with the public safety community[4] appears to be that if the public safety community wants FCC support for funding the network build-out, it needs to accept the rest of the FCC's recommendations in the NBP report.

The public safety community has responded that the funding is immaterial without enough broadband spectrum to build out the network and has concentrated on pointing out the need for additional spectrum, the willingness of commercial operators to work with public safety, and the fact that even the funding model used by the FCC is flawed.

[1] http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296504A1.pdf
http://www.fcc.gov/pshs/docs/speeches/Jamie-Barnett-Comm-Sector-Remarks-04072010.pdf
[2] http://www.npstc.org/documents/PERF-SubjectToDebate.pdf
[3] http://www.opencongress.org/bill/111-h5081/show
[4] http://andrewseybold.com/1518-fcc-a-political-organization

In its latest effort to convince others that its vision for a nationwide public safety broadband network is correct, the FCC has published a white paper[5] that recaps and further explains its rationale for its funding estimates.

Our response takes issue with many of the FCC's assumptions, calculations, and recommendations. For clarity, we have chosen to model this rebuttal on the white paper that was released by the FCC on April 23, 2010, and to discuss these points so they may be easily compared to statements included in the FCC document.

In addition to the issue of funding for construction and maintenance of a nationwide broadband network for the public safety community, there remain a number of other issues including, but not limited to, the amount of bandwidth the FCC believes should be allocated to a standalone public safety network and its assumption that the public safety community will have total, complete priority access to all of the commercial spectrum within the 700-MHz band as it is deployed by the license holders. These issues have been addressed in other articles[6] and publications but have not had as much of an impact on the overall FCC plan as the funding model.

We believe that the FCC white paper is based on flawed network assumptions and design and, therefore, the financial calculations are also flawed. In the body of this paper, we will prove that the entire FCC white paper is based on faulty and unsupported logic.

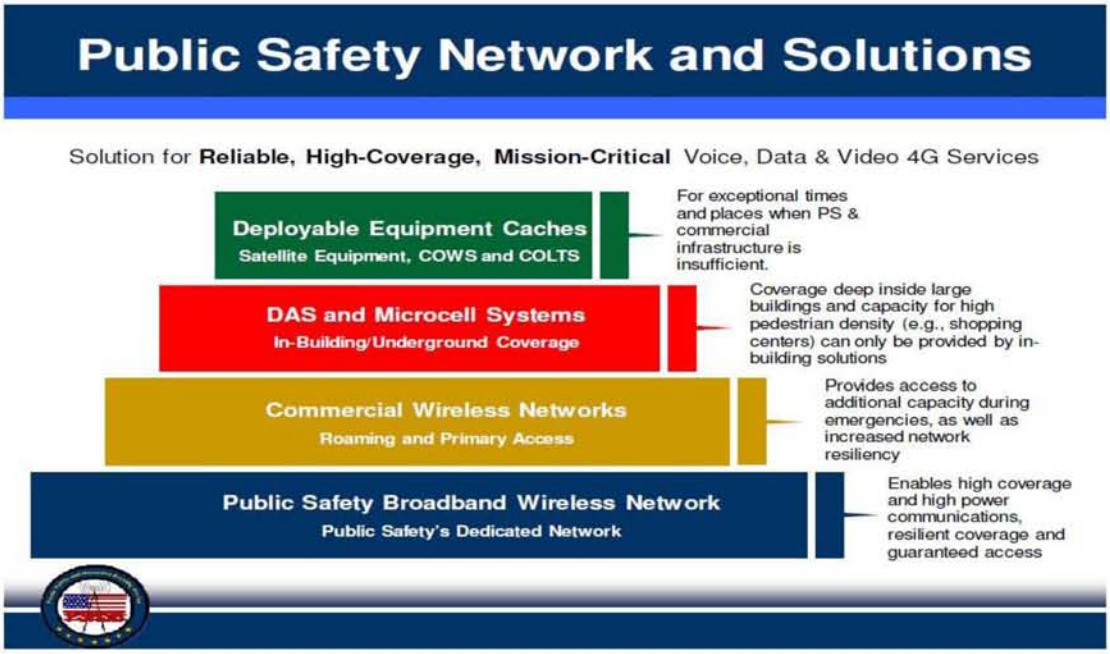
[5] http://download.broadband.gov/plan/fcc-omnibus-broadband-initiative-(obi)-technical-paper-broadband-network-cost-model-basis-for-public-funding-essential-to-bringing-nationwide-interoperable-communications-to-americas-first-responders.pdf
[6] http://andrewseybold.com/1548-fcc-spectrum-plan-based-on-faulty-logic

A. Introduction

The Introduction section of the FCC white paper discusses the vision of the NBP to provide "*cutting-edge*" broadband technologies and access to commercial technologies, but at much lower costs. The public safety community specifically, and the wireless community as a whole, have shared this vision for many years. However, if this goal is to become a reality, it will need to be funded appropriately, and will need ongoing support for network operation.

To illustrate this objective, the FCC has included the following diagram and explanation of its multi-pronged approach to solve public safety's communications issues:

Exhibit 2: The Future of Public Safety Broadband Communications



We believe that some false assumptions were made in the crafting of this diagram. First, it appears that the FCC intends for the public safety broadband network to be capable of higher power and to be designed differently from commercial networks within the 700-MHz band. This does not accomplish the stated goal of making use of off-the-shelf commercial technologies, nor does it address the issue of potential interference between public safety and commercial networks. Is the FCC suggesting that the public safety broadband network be another one-off network and not conform to industry standards for broadband networks within the 700-MHz band? If this is really the intent of the FCC, then its assumptions regarding deployment costs are based on this premise and not on providing network architecture in keeping with today's commercial networks or published standards for the technology.

Having a public safety network that runs more power than adjacent commercial systems, with its design based on higher power for both cell sites and devices, has far reaching implications. First is the issue of roaming onto commercial networks with devices that are capable of running higher power than typical commercial devices. Fourth-generation networks control the power output of the mobile device by measuring the signal strength from and to the device and sending signals to the device to adjust the power. If public safety is to make use of higher-power devices, the ability to share common network services with commercial network operators will be compromised, and/or it will mean that each network (public safety and commercial) will need different levels of power management built into them.

Further, if the FCC's intent is to provide higher-power cell sites and devices so fewer cell sites will need to be constructed for the public safety portion of the network, this will also have an adverse effect on the capacity of each cell site, as well as the broadband speeds of these cells, especially at the cell edges. The public safety community has already proven to the FCC that 10 MHz of spectrum will not be sufficient[7] for normal, day-to-day operations, and if the number of cell sites is reduced because higher power is permitted for these sites, the capacity of the overall network will suffer even further. The sensible approach is to design the public safety network in accordance with commercial industry standards for cell density and location. Since it appears as though the FCC financial model was based, in part, on this design criteria, the entire financial model is suspect.

The FCC's diagram shows that public safety will have roaming and primary access on commercial networks that will *"provide additional capacity during emergencies as well as increased network resiliency."* This too is based on faulty assumptions since our calculations[8] and those of others[9] indicate that given the lack of spectrum presently assigned full time to the public safety community, its need to roam onto commercial networks will occur multiple times per day, at least in the top 100 markets. We believe this could easily strain the existing relationship between the public safety community and the commercial license holders. Making sure that public safety roams onto the commercial networks on an *"emergency basis"*-only will require many more cell sites for the public safety network and more broadband spectrum.

During emergencies, commercial networks are typically saturated, which is why public safety needs its own network or, at minimum, a shared network with sufficient spectrum exclusively for public safety. During local emergencies, customers on the commercial networks saturate the network by picking up their cell phones and calling their friends and family members to see if they are safe and to share information and experiences, and every local emergency results in a media response, further saturating the network. Commercial networks fail sooner than public safety networks, so how can commercial networks back up public safety networks?

[7] http://andrewseybold.com/1338-public-safety-broadband
[8] http://andrewseybold.com/1548-fcc-spectrum-plan-based-on-faulty-logic
[9] http://urgentcomm.com/policy_and_law/commentary/fcc-makes-it-worse-20100423/index.html

Next on the chart is the box depicting DAS (Distributed Antenna Systems) and microcell systems for *"in-building and underground coverage."* We agree that this type of equipment will be needed for both public safety and commercial networks. However, we do not see the cost of this equipment included in the FCC's white paper presentation. In metropolitan areas, this type of network deployment can add substantially to overall network deployment costs.

Further, commercial operators that will be deploying small cells, known as femtocells, will require customers to provide their own connection back to the network. At present, this connection can be over DSL or cable modem, and then over the Internet. Therefore, femtocells cannot be considered as mission-critical devices, and their data capacity will be limited by the capacity of the DSL or cable line used to transport the signals back to the network.

The last part of the diagram shows what is called *"deployable"* equipment that is cached at specific locations and deployed on an as-needed basis. This technique has been used by the fire service for years,[10] and has proven effective. However, we believe costs for this equipment are grossly understated and we can find no indication of the inclusion of costs for storage, routine maintenance, or deployment of these caches of equipment.

This one diagram casts doubts on the entire report. A number of the assumptions are not based on real-world understanding or expertise and these assumptions impact all of the budgetary numbers that follow.

The next section of the white paper discusses the costs the FCC believes will be incurred in building and operating the network. It states that costs over the next 10 years will be in the $12-$16 billion range and with state and local governments taking part in some of the funding, the federal government's contribution should only be $6.5 billion for CapEx, which it goes on to justify in the balance of the paper. It further discusses the formation of ERIC, the Emergency Response Interoperability Center that will *"set common standards and practices for the nationwide network."* However, there do not appear to be any costs associated with this government organization to operate ERIC, and we question whether this is even within the purview of the FCC since the Public Safety Spectrum Trust (PSST) is the license holder of the spectrum. According to the FCC's website, the ERIC mission is as follows:

"The mission of the Emergency Response Interoperability Center is to establish a technical and operational framework that will ensure nationwide operability and interoperability in deployment and operation of the 700 MHz public safety broadband wireless network.

ERIC will adopt, implement, and coordinate interoperability regulations, license requirements, grant conditions and technical standards. The Department of Homeland Security and the National Institute of Standards and Technology will contribute to ERIC's functions."

[10] http://www.nifc.gov/communications_radios.htm

While it is not the purpose of this document to discuss the pros and cons of having a federally operated interoperability center, it should be noted here that the public safety community has already developed a set of working criteria for networks[11] that will join in the creation of a nationwide public safety broadband network. It appears from the FCC white paper that one of the primary purposes of ERIC will be to ensure that any public funding will go to organizations and agencies that comply with ERIC requirements.

The final paragraph of the introduction states that:

"The cost model the NBP used to calculate capital expenses and ongoing costs for the network and to inform its recommendation for the public funding program was validated through multiple approaches. First, a detailed radio frequency (RF) model was constructed, and its RF assumptions were validated through a technical analysis that used data acquired from several major commercial service providers, their competitors, and vendors. Costs were based on appropriate comparables, including tariff rates, actual proposals from service providers for similar network builds and operations, and information obtained directly from service providers, equipment vendors, and integrators. Detailed cost scenarios were also developed—and compared with cost scenarios provided by service providers and equipment vendors—to further validate costs."

This set the stage for what those who contributed to the FCC white paper perceive as undisputable facts regarding cost models. However, since the entire network design proposed by the FCC in this paper and in other documents is not based on real-world scenarios, and include the issues we have identified above as well as others, the entire pricing model is suspect. It appears from reading the pages of the paper and discussing them with at least one of the authors, that the cost questions were asked about a design that was already conceived by the FCC. Further, the only information sought from these companies and organizations were answers to specific funding questions rather than a discussion of the fundamental network design and concept.

We believe that if the Commission had asked each of the equipment vendors and integrators it asked about this network, as conceived by the FCC, was practical and whether it would truly meet the needs of the first responder community, the answers and cost estimates would have been very different. The FCC started from a point of believing that 10 MHz of dedicated spectrum will be enough for public safety for the foreseeable future and that most of the networks that will be built will make use of existing commercial cell sites in conjunction with existing public safety sites. The proven reality of the situation is that as envisioned by the FCC, the public safety community will have to make use of commercial spectrum on a daily basis, and this will put a strain on the commercial operators as well as the public safety system.

[11] http://www.npstc.org/documents/700_MHz_BBTF_Final_Report_0090904_v1_1.pdf

In its white paper, the FCC envisions this 10 MHz of spectrum being used not only to carry data and video broadband services but, over time, mission-critical voice and other services. This will compound the issue of not having enough bandwidth on a daily basis, especially in major urban areas. The public safety community, commercial network operators, and equipment vendors (the same ones the FCC relied on for its pricing models below) have already provided the FCC with quantitative data that disputes the FCC's assumptions that 10 MHz of broadband spectrum will be sufficient for the public safety community.[12]

In response to this additional data, the FCC has stated that *IF* it is wrong and more spectrum is needed, it will *"find"* additional frequencies in another portion of the spectrum, which means the FCC will only be compounding the problem of interoperability, network and device complexity, and costs. For decades, past Commissions' failure to allocate sufficient spectrum for public safety communications has resulted in public safety having spectrum resources spread out over many different portions of the spectrum, making interoperability both difficult and expensive to achieve.

B. Assumptions

In the first part of the Assumptions section of its white paper, the Commission outlines what it believes will be a move by public safety to make use of the broadband network for voice, including mission-critical voice services. The evolution as described in the paper is for data and video services first, followed by interoperable mission-critical voice. The report does not make any distinction between the two types of voice services required by the first responder community, neither of which is supported by commercial networks today, and one that is not even on the roadmap for fourth-generation wireless broadband technology. The first type of voice service is one-to-many voice communications, which is a vital element of public safety communications. The second type is the ability for public safety organizations to communicate by voice when they are out of range of a cell site or on an incident that requires one-to-many direct communications.

Because the one-to-many direct communications voice requirement is specific to public safety, and is a core differentiator between commercial wireless voice services and public safety voice services, there is no interest within the commercial wireless community to provide this functionality. Further, the chances of the public safety community having these requirements included in future releases of fourth-generation technology are slim to none. There are a number of technological challenges here and commercial network operators are not interested in providing off-network peer-to-peer or one-to-many voice communications services[13] since they could negatively impact their revenue. Add to this the fact that the command-and-control

[12] http://andrewseybold.com/1548-fcc-spectrum-plan-based-on-faulty-logic
[13] An email to FCC Commissioner McDowell: http://andrewseybold.com/1456-channellized-communications

functions of commercial devices are controlled within the network and not on the device, and it becomes obvious that to include this type of communications capabilities to support 3-4 million customers out of a total customer base of more than 285 million would not make financial sense and will not be included in new versions of the LTE standard developed by the 3GPP.[14]

The next paragraph in this section is also telling since both Verizon and AT&T are already well underway with their 700-MHz construction programs. In fact, Verizon is far ahead in the construction of its network and expects to launch LTE broadband services in the top 30 markets in 2010, covering 100 million POPs and heading for full nationwide roll-out by 2013.[15] Meanwhile, the FCC has failed to act on any of the waivers that have been submitted requesting permission to start building out on the PSST's already licensed spectrum. The FCC's white paper assumes that public safety and commercial networks will be built out together, which is clearly not possible since Verizon is already well on its way toward a nationwide build-out, AT&T is a year behind at most, and the issues with public safety relating to the amount of spectrum and funding have yet to be resolved.

Had these waiver requests been granted in a timely fashion, some of these systems would already be underway in conjunction with commercial operators and we would be within a few months of proving conclusively in actual network operations that the 10 MHz of spectrum allocated to first responders is not sufficient to meet their broadband data demands, and certainly not enough to support data, video, and mission-critical voice services.

This means that savings that might have been possible with a simultaneous build-out of both systems will not happen, at least in the top 100 markets, and this will result in increased costs for the public safety build-out going forward. Even if Congress and the FCC act swiftly with spectrum allocations, new priority access rulemaking, and funding, the window for dual, simultaneous build-outs will have passed.

Commercial operators have no incentive today to design their sites for co-location of public safety systems, or to harden their sites in anticipation that public safety will receive both the approval and the funding to move ahead on a regional basis. There are a number of public safety systems that are in the planning stages but, like their commercial counterparts, they cannot develop network designs that include co-location on sites, and they cannot plan on cost savings from sharing back-end infrastructure and facilities. Thus these systems are being designed to be standalone systems that will meet the stringent requirements for first responder reliability and could be connected to commercial systems in the future.

[14] http://www.3gpp.org/LTE
[15] http://news.vzw.com/news/2010/03/pr2010-03-22c.html

The third paragraph of this section discussed not only the projected coverage of 700-MHz commercial networks, but also the power levels required for the devices to be able to work within these networks. It goes on to state that public safety will be *"able to achieve better coverage and performance than commercial systems by using higher-gain (more powerful) devices with specialized antennas."* This statement, once again, is based on the assumption that commercial and public safety networks will be designed differently and that the public safety network cell sites and devices will be able to run more power to compensate for fewer cell sites. This premise is based on neither sound engineering nor economic criteria.

The FCC appears to assume that the majority of public safety broadband usage will be from within a vehicle where power for devices is not an issue. The reality of the situation is that the public safety community, like the business and consumer communities before them, will require devices that are carried on the person and, therefore, will be limited in power output, antenna design, and battery life. Increasing the power of these devices will greatly reduce their battery life, and could easily cause interference to commercial network cell sites within proximity of the public safety devices.

One of the most troubling of all paragraphs in this section reads:

"Ongoing costs were also calculated on the basis of an incentive-based partnership model. This model assumes that backhaul, core network, managed IP services and ancillary services will be paid through an operating expense charged through a managed service fee. This managed service fee is based on the existing air card managed service fee structure—with the radio access network (RAN) share of the service eliminated, since public safety partners will be using their own spectrum for their primary service."

The commercial wireless community has already drastically changed its business models for broadband pricing. Gone are the days of unlimited broadband services for a fixed monthly fee. This has been replaced with tiered pricing for 50 MB or 5 GB of service per month for laptop systems, and network operators are currently reviewing their options for smartphone broadband usage. Once fourth-generation systems are in place and available to customers, there will be further changes in customer pricing as ways to better manage data usage become necessary. AT&T [16] has reported that only 3% of its iPhone customer's account for more than 40% of its iPhone data traffic on the network, and other operators are finding that they need additional ways in which to manage and control wireless broadband usage. These new pricing discussions have been reported in the press for the past year, yet the FCC seems to be basing its cost estimates for the public safety community on pricing models that were abandoned several years ago.

[16] http://online.wsj.com/article/SB10001424052748704240504574586160553502526.html

Next, the FCC has not factored in the cost of a commercial operator having to split its back-end network to provide for increased security and services for the first responder community, nor has it taken into account the additional hard costs for splitting the back-end services into commercial and mission-critical segments. The commercial operators have expressed a willingness to work closely with the first responder community, but they are not prepared to lose revenue or take a chance on losing commercial customers to provide secure and mission-critical services for public safety.

Commercial operators are in business to make a return on their investment, and they must answer to their stockholders. It was recently reported by Verizon Wireless[17] that its revenue from data services has reached 30% of its total quarterly revenue; the balance was from wireless voice services. As demand for broadband data grows, so too, will the income. However, the FCC certainly cannot expect companies such as Verizon or AT&T to reduce their ability to service their commercial customers and provide them with the best possible broadband experience in order to provide additional capacity that will be needed on a daily basis by the public safety community if its spectrum holdings are limited to 10 MHz of broadband spectrum.

The final paragraph in this section deals with the FCC's determination that the public safety community can make do with 10 MHz of spectrum. One of the reasons provided by the FCC is that there will be roaming on commercial wireless networks. It appears as though the FCC has interpreted the data provided to it in such a way as to believe that this need for use of commercial spectrum will be on an occasional and infrequent basis. The data we have reviewed[18] indicates that if the public safety community must operate within the confines of the 10 MHz presently assigned to it, its encroachment into the public spectrum, on a priority basis, will occur multiple times a day in major metropolitan areas.

The FCC seems to believe that transportable infrastructure will be available to add capacity when there is an incident that requires more bandwidth. It is also relying on in-building supplemental systems to provide resiliency for capacity surges, increased coverage, and increased redundancy. What it is missing is that public safety must respond within minutes and has literally minutes in which to contain a situation that could easily become a major incident. If the communications resources are not available at the start of the incident and first responders have to wait until they can be trucked in, the value of those communications resources is greatly diminished for many incidents.

There appears to be a lack of understanding within the FCC as to how important the first 10, 15, or 20 minutes of an incident are, or how the odds of catching perpetrators or saving buildings decrease only a few hours into the incident. It is obvious to us that the FCC is equating public safety requirements only to events that stretch over multiple days or weeks such at hurricanes or other disasters. Most of the incidents that will require full broadband capacity will require

[17] http://news.vzw.com/investor/20100422.pdf
[18] http://andrewseybold.com/1548-fcc-spectrum-plan-based-on-faulty-logic

that capacity within the first few minutes or hours. Beyond that, for the majority of incidents, there will be fewer requirements, and there will not be the same concentration of first responders on and around the scene.

C. Capital Expenses (CapEx)

This section of the Commission's white paper outlines the total funds it believes are needed for Capital Expenses over a 10-year period. The bottom-line number is $6.5 billion, and in the paper it claims that that figure will provide public safety broadband services for 99% of all Americans. These expenditures are further broken down into $4.0 billion for equipment for commercial towers, $1.5 billion to harden commercial towers, $0.8 billion to equip 3,200 rural towers with public safety broadband spectrum radios, and $0.2 billion for public safety deployable network sites.

Item	Cost	Notes
41,600 Commercially Deployed Non-rural Sites	$4.0 B	Excludes hardening costs. Ethernet over fiber backhaul connectivity to commercial carrier's backhaul Assumes PS RAN (lit) added to 100% of sites (conservative)
Hardening of Existing Commercial Sites	$1.5 B	Assumes 100% of sites need hardening (conservative)
3,200 Rural Sites (includes hardening)	$0.8 B	Assumes EMA, Blend of 25% new and 75% upgraded sites
Deployable Equipment and Development	$0.2 B	
TOTAL CAPEX	**$6.5 B**	

Based on this model, a reasonable year-by-year projection capital expenses is as depicted in Exhibit 4:[11]

There are a number of other charts and graphs in this section that break out in more detail how and when these funds will be needed and in what year of the 10-year project. This budget does not include any costs that might be incurred for roaming by the public safety operator on a commercial network. The use of the word MIGHT in this omission of costs again demonstrates that the Commission believes that 10 MHz of public safety spectrum will be sufficient for its use with only the occasional requirement to roam onto commercial networks. As we have stated, this is one of the items in this report, and in the National Broadband Plan, to which we take exception.

We will comment on the Commission's budgetary Capital Expense figures below, especially when examining the more detailed expenditures outlined in Appendixes B and C, but once again, we believe that none of the assumptions on which this capital expenditure budget result in real-world estimates, nor do they take into account planning and engineering costs, increased site rental fees due to additional antennas required on the cell sites, or any contingency funding. Sound business practice would see an inclusion of contingency funds of between 10% and 20% of the total project, which, in itself, would raise the Commission's budget to between $7.15 and $7.8 billion.

D. Ongoing Costs

In this section of the paper, the Commission discusses its assumptions and the amount of projected ongoing costs. It indicates that by year 10 of the project, the ongoing costs will be $1.3 billion per year broken out as shown in the following chart:

Exhibit 5: Ongoing Network Costs Chart

Item	Cost	Notes
Annual OA&M Including Transport Managed Services Fee	$0.9 B	For 3 M Public Safety Subscribers at $25 per month
Annual RAN Managed Services Fee	$0.2 B	44,800 Sites at $1500 per year for site equipment, OA&M, and $2400 for additional lease cost (this achieves a 99% population coverage)
Additional costs in rural areas (microwave backhaul, additional site lease costs, deployable OpEx)	$0.2 B	Microwave antenna, power and maintenance lease; miscellaneous ongoing costs
TOTAL ONGOING COSTS	**$1.3 B**	

There is a caveat indicated as footnote 12, which states:

"*The proposed funding covers network operations. The funding is not intended to cover the operations of the services and applications running on top of that network nor various administrative functions associated with public safety network operations that agencies may incur. These costs which are part of day-to-day operations today which we have assumed will continue to be borne by the local agencies.*"

Again, since our basic premise is that we do not believe that the underlying assumptions on which this white paper are based are correct, we do not believe the numbers cited are representative of the true ongoing costs of the network, and we will address our concerns later in this document.

E. Cost of Separate Public Safety Network

In this part of the paper, the Commission continues to try to make its case that the cost of its "incentive based" network design described in section B of the paper is $6.3 B but that the cost of an entirely separate network would be $15.7 B. However, it states that "*the cost of the Stand-Alone network described here are less detailed, in part because of the potential range of ongoing costs."*

The Commission seems to believe that there are only two choices for building out the public safety broadband network. The first choice is its option to essentially combine it with the commercial networks except for some of the radio equipment. The second is to provide a totally separate and standalone network. The FCC does not take into account that between these two extremes are a number of options that can and should be explored. In some parts of the country, the Commission's vision might, in fact, be the best one, in some areas the public safety community will need complete standalone systems, and in other places there could be a combination of the two options offered. For example, it would not be out of the realm of possibility for a core public safety network to be built in a high-use urban area that is not augmented by additional shared sites provided in conjunction with commercial operators. Nor should the possibility of sharing back-end and IP services with commercial operators while maintaining both commercial combined sites and existing public safety sites be ignored.

The Commission is only looking at the two extremes in this paper. It still believes that a total of 44,800 sites will be needed by the public safety community, but states that in its incentive-based partnership it considers the *"marginal cost"* of adding a new radio access network (RAN) for public safety to an existing tower site. Later in this paper, it presents the costs of providing this separate RAN using a common, across-the-board number per site. Reality is quite different.

As commercial network operators build out their own LTE or fourth-generation networks, they will be upgrading their sites in a number of ways, depending on what equipment is already in place, how old the equipment is, and other factors. In some cases, these upgrades will require all new equipment with fiber or microwave backhaul. In others, they will be able to add LTE capabilities to their existing RAN along with new antennas and filtering, and in some cases they will have to find new sites because the sites they presently occupy are saturated and unusable for additional RAN and antennas. Another point that has not been considered in the FCC's white paper is that sites are not always owned by the commercial network operator and can be owned by a third party who rents space to the network operators.

The paper states that *"the differences emerge in the cost per cell site: both CapEx; and OpEx; the costs in zoning and site acquisition, because of many more new cell sites beyond the base required for public safety LMR (Land Mobile Radio) networks; the costs of backhaul from the cell sites; and the costs for the core network."* The Commission has apparently, once again, not considered any options between the two extremes, including sharing backhaul and IP back-end resources with the commercial network operators, acquiring access to sites already developed

but owned and managed by third-party tower owners, and other combination solutions. Therefore, we disagree that there is the large cost differentiation detailed in the paper and believe that the real CapEx number lies somewhere between the two extremes.

Exhibit 7: Incentive-Based Partnership vs. Stand-alone Public Safety Network Capital Expenses

Comparison Cost of 44,800 Sites		
	Incentive-Based Partnership	Stand-Alone Public Safety Network
Urban Upgraded Site	$95,000	$163,752
Urban New Site	N/A	$223,752
SubUrban Upgraded Site	$95,000	$213,752
SubUrban New Site	N/A	$288,752
Rural Upgraded Site	$216,000	$247,232
SubUrban New Site	$363,000	$394,632
Total CapEx for Sites including Hardening	$6.3 B	$12.6 B
Backhaul - Installation to Core Fiber Ring, Non-Rural Sites	$0	$2.1 B
IP Core Equipment, Network Operations Centers	$0	$1 B
TOTAL CAPEX	**$6.3 B**	**$15.7 B**

The paper continues that in the analysis, *"we considered the complexity and scope of constructing a nationwide public safety network, in which 80% of the 44,800 sites would be new builds."* We disagree with this assumption as well. There are a number of ways to provide access to existing sites for the public safety community, including requirements that any new commercial site constructed be made available, reduced time for permitting if public safety is included in the construction, and other incentives for tower and land owners. Comparing the two extremes in costs in order to justify the Commission's recommendations does not give fair consideration the other available options.

The Commission also neglected to look at the costs to increase the public safety spectrum from 10 to 20 MHz as has been requested and introduced as a pending bill (H.R.5081). The actual costs associated with the addition of 10 MHz of spectrum (the D Block) are minor when compared with the future costs of having to allocate additional broadband spectrum for public safety in yet another portion of the spectrum. The costs for a new spectrum allocation could easily drive the cost of the overall network up by 50% to 75%. The addition of the 10 MHz of adjacent spectrum would only increase the total network costs by 15%-25%.

The Commission's final cost figure for a complete, standalone network including both CapEx and OpEx is $34.4 billion over a 10-year period. Once again, we dispute this number, which the Commission claims is based on documents referenced in the footnotes of the report. Again, the Commission's position is that there are only two options for building and maintaining the public

safety broadband network: Its incentive-based network plan or a complete nationwide standalone network owned and operated strictly by the public safety community.

While the public safety community wants and needs its own standalone network that is hardened and secure, there will be trade-offs in different areas of the nation. The series of networks that will eventually be constructed will be made up of a combination of standalone, partially shared, and perhaps even fully shared systems. The Commission's assumption that these networks will be all of one type or another is not correct. Another point worth making is that on the federal government side of law enforcement, there are a number of nationwide, standalone networks that are not shared and are considered to be required because of the needs of the agencies. These networks include the FBI, DEA, Secret Service, and others. Yet the Commission seems to be saying that the state and local public safety community does not have the same needs as these federal agencies. Therefore, public safety should make do with a shared network and less broadband spectrum than it has proven it needs.

In the same section of the paper, the Commission states, "*This lack of scope is compounded if the public safety entity is operating on an LTE network that utilizes spectrum in a band class assigned exclusively for the public safety community. This would be the case if the D block was reallocated to public safety. In that situation, there would be no commercial service provider in LTE Band Class 14 in the 700 MHz band. While technically such a system could be deployed and supported, the costs of the network equipment, most notably the devices, would increase substantially. Without the ability to leverage the economies of scale of a commercial deployment in a band class, there is significantly less market incentive to develop network equipment and devices capable of operating in that band. Therefore, public safety would have to pay significant premiums for equipment and devices under such a scenario.*"

This would be a valid point if public safety LTE devices will be built for Band Class 14 only. However, in our conversations with the microchip suppliers, we have determined that all of the basic chips support Class 14, and that while there will need to be changes made to the software masks, some filters, and other components, most of the devices that will be used will be capable of providing service across both the public safety and commercial networks. It is also true that the public safety community is not expecting to be able to purchase broadband devices in their local communications stores. Because of the unique needs of the public safety community, many of the devices will be built specifically to meet public safety's requirements and will, therefore, be priced higher than a $200 smartphone for commercial use. However, the overall cost savings will be substantial and we believe that the industry is willing to work with the public safety community to provide the types of devices it requires at reasonable costs.

Appendix A: Deployable Equipment

This Appendix discusses the inclusion of the deployable caches of equipment that are included in the public funding proposal, which should continue to be a requirement for the overall public safety broadband network. However, it also includes funding for Non-Recurring Engineering (NRE) costs to ensure that specialized chipsets and software will be developed to meet the

needs of the first responder community. This contradicts the statement in Section E above, which states: "*This lack of scope is compounded if the public safety entity is operating on an LTE network that utilizes spectrum in a band class assigned exclusively for the public safety community.*
This would be the case if the D block was reallocated to public safety. In that situation, there would be no commercial service provider in LTE Band Class 14 in the 700 MHz band. While technically such a system could be deployed and supported, the costs of the network equipment, most notably the devices, would increase substantially. Without the ability to leverage the economies of scale of a commercial deployment in a band class, there is significantly less market incentive to develop network equipment and devices capable of operating in that band. Therefore, public safety would have to pay significant premiums for equipment and devices under such a scenario."

The Commission has recognized the need to incent chipset vendors and others to build chipsets and other components capable of providing devices for use in the public safety spectrum, and our discussions with these vendors over the past year indicate that the NRE involved would be the same for developing products only for the 10 MHz of public safety spectrum or for the combination of the D Block and the public safety spectrum. Further, in the overall system costs, these NRE fees will amount to single-digit $millions, and will not have a material impact on the overall cost of the system.

Appendix B: Network Cost Model Assumptions

In this Appendix, the Commission lays out its assumptions that were used to support its costing models and to support its recommendations that the D Block be auctioned in order to provide a commercial network operator that *will "simultaneously build out the LTE Band 14 profile that includes both the D block and public safety spectrum."* However, the proposed D Block spectrum auction rules have been stripped of any requirements for the auction winner to work with the public safety community except to provide priority access.

It is possible, and perhaps likely, that the winner of the D Block auction will decide it can build its own system out quicker and with less expense than by sharing the costs and having to include the hardening required for many of its sites, even if the costs were included in the funding for the public safety network. Any new operator that won the D Block auction would already be several years behind the existing 700-MHz commercial license holders and would, therefore, be incented to move ahead rapidly on its own.

One of the network operators that has expressed interest in bidding on the D Block indicated to us that 10 MHz of spectrum is not enough 700-MHz spectrum for it to be able to compete with the existing license holders, and that if the D Block and public safety systems are built out as separate systems, some spectrum will need to be left fallow between the two systems to prevent interference. This will reduce not only the amount of spectrum available for the D Block

winner, it will also reduce the amount of spectrum available for public safety. This, in turn, will have a negative impact for both operators and will reduce both their capacity and their data rates.

The Commission seems to believe that adding another commercial network operator to the mix of existing license holders will put additional pressure on broadband pricing, and that having only two network operators in the band will not provide the same level of competition. This is based on the fact that the two largest network operators have licenses on a nationwide basis. It does not take into account that on a region-by-region or city-by-city basis, there will be three or more broadband providers in the 700-MHz band.

The next point has to do with the subscriber device model and the Commission's assumption that public safety personnel will be able to use larger devices with external antennas and larger batteries, gaining a power advantage over commercial devices. Again, this does not take into account that these devices will also have to be capable of operating on the commercial networks, which are not being designed to accommodate these increased power levels, and some adjustments will have to be made to provide the necessary safeguards if higher-power devices are employed.

Most of the other assumptions in this Appendix have been discussed in detail in other portions of this paper. However, it is worth repeating that the entire Commission plan for the public safety broadband network is based on this statement:

"Priority wireless service on commercial networks, deployables and in-building Supplementation provides for capacity surges, more extensive coverage, and more resiliency thus lowering site requirements on core network."

If required, as we believe they will be on a daily basis in major metro areas, priority wireless services on commercial networks will create both short and long-term issues for both the public safety community and the commercial operators that are trying to keep their commercial customers happy while at the same time accommodating the public safety community. The best way to ensure that public safety's roaming requirements are minimized during normal types of emergency calls is to provide the additional 10 MHz of spectrum known as the D Block.

Again, it should be recognized by the Commission that between the two network extremes discussed in its paper, there are many viable options for public safety and commercial operators working together. If public safety has the spectrum it needs (20 MHz), the level of cooperation will be better on both sides and we believe that more areas of this country will be willing to embrace different types of partnering arrangements when they know they have full and complete access to the bandwidth they need on a daily basis.

At the end of this Appendix is a final statement: *"The model will be refined based on real-life experience in future public funding years."* This means that if the above assumptions are wrong, as we believe they are, then the pricing models are also wrong, and the public safety community could not only be left without enough spectrum for its needs, but with half-completed networks across the United States as well. We have to wonder whether the Commission and Congress are willing to take these risks.

Appendix C: Underlying Equipment and Cost for Capital Expense Assumptions

Here again, a number of the issues we have discussed above are applicable to this Appendix as well. However, we do have some additional observations:

1) Diagrams A and B for Non-Rural site configurations contain detailed lists of equipment and funds for engineering and installation. We find it interesting that these diagrams and their associated pricing are so complete and include equipment down to the most basic levels. It appears as though the authors of this paper were trying to convey a sense of thoroughness in their pricing assumptions. However, their pricing assumptions are based on a flawed system design level as discussed above, and they did not include any contingency funding on a per-site basis. Their assumption appears to be that these numbers would average out across the country. It is not productive in this paper to compare and contrast every item listed in the bills of materials in these diagrams, but we do believe that these estimates are low and that the actual costs will be considerably higher, especially in areas where commercial operators have already built out their networks.
2) Hardening: The assumptions are listed on page 23 of the paper and include generators and associated equipment. However, they do not take into account the fact that many urban cell sites are located on the tops of buildings and it is not possible to add generators due to the weight of the equipment, the storage of flammable liquids, and local ordinances. These sites will have to be hardened in different ways with a different set of cost parameters. Again, we question the costs presented in this section.
3) Microwave System: These prices, while documented, are on a site basis and appear to provide a single path back to either another site or a hub. At the very least, the network hardening should include dual-diversity antennas, and for major sites, a second path to a different entry point within the network.
4) Fiber: There are no cost assumptions listed for fiber, which is also being used for backhaul at many sites, especially within urban areas where microwave (which requires line-of-sight) cannot be deployed. If the assumption is that the public safety system will make use of existing fiber and not need additional fiber connections, we find this to be shortsighted.

Since we believe that the system design and amount of available public safety-only spectrum are based on faulty assumptions, we also believe that all of these cost estimates should be increased to reflect real-world system design criteria.

Appendix D: Capex for Public Safety 700 MHz Builds-Stand-Alone

This section also assumes that each and every network that is to be integrated into the public safety nationwide system will require 100% standalone towers, equipment, backhaul, and back-end services. This would represent the ideal world for public safety—one common network for public safety on a nationwide basis with no equipment or commercial sharing—and it is what the public safety community needs and deserves. However, there is a reality here that there must be compromise if the network is to be underway in a timely and more cost-effective manner.

Conclusions

The Federal Communications Commission seems to be perplexed that the public safety community did not simply endorse the recommendations contained in the National Broadband Plan in Chapter 16. It attempts to make the case that public safety does not need more than 10 MHz of spectrum even though the data provided shows otherwise. It seems to believe that what is best for the nation is to ensure that a third commercial network provider be empowered with its own 10 MHz of spectrum and it has rationalized that public safety can make do with its own 10 MHz of spectrum and sharing, on a priority basis, with all of the commercial operators.

Historically, public safety on a federal, state, and local level has not had to compete with consumers for use of spectrum and has had what little spectrum it controls available to it on a 24 by 7 basis. But now the Commission believes it will not impact public safety communications to have to share spectrum and contend for bandwidth with those who may be viewing streaming video, surfing the web, or playing multiplayer games across the network.

The Commission appears to be baffled that public safety wants 20 MHz of contiguous spectrum and won't settle for a promise that if it needs more than 10 MHz of spectrum it will be supplied at a later date, in yet another portion of the spectrum. It does not seem to comprehend that the reason the public safety community has an interoperability problem in the first place is that over many decades, previous Commissions have allocated small slices of spectrum to public safety and never enough contiguous spectrum to be able to develop and implement interoperability for its voice services.

Now this Commission is about to make the same mistake when it comes to broadband spectrum allocations and leave it to a future Commission to, once again, dole out another sliver of spectrum in yet another portion of the spectrum. At the same time, it is telling the commercial operators that it will find them up to 500 MHz of additional spectrum over the next 10 years and that 300 MHz of this spectrum will be allocated within the next 5 years!

The white paper released on April 23, which is the subject of this paper, is one more way in which the FCC is trying to justify its position and once again short-change the public safety community. It is disappointing that the FCC feels it needs to prove that its plan is the only plan that will work, and by issuing veiled threats, make it clear to the public safety community that if it wants the support of the FCC when it comes to federal funding requests, it needs to endorse the NBP as it has been written.

The white paper does not accomplish its goal. Instead, it makes it clear that the FCC's plan for public safety was, from the start, based on flawed logic and data points that were molded to suit the Commission's beliefs. It was not based on fact, and largely ignored the input provided by the public safety community, commercial network operators, and equipment vendors, all of whom have the experience and knowledge to understand the issues and to prove that 10 MHz of spectrum is not enough for public safety even at the outset, nor is it possible for public safety to share bandwidth with business and consumer customers whose broadband usage peaks at the same time there is maximum demand for bandwidth from the public safety community.

It is even more difficult to understand why, given the opportunity to rectify errors made by previous Commissions at little additional cost to taxpayers, the Commission did not, from the outset, simply propose as part of the National Broadband Report that public safety needed the full 20 MHz of spectrum, and that this would not preclude the public safety community, as well as the commercial community from working together to build a world-class public safety network that would provide, most of the time, the bandwidth they need on a daily basis.

Several times over the last few months, the FCC has indicated that there was no support for the public safety position as advocated by all of the major national public safety organizations and endorsed by major network operators and vendors. Now that there is movement within Congress to address this issue, those within the FCC feel they have to justify their position rather than agree to take a new look at the issues and modify their plan.

Those reading the FCC's white paper who does not understand all of the issues will probably be convinced by all of the charts and graphs that the FCC plan is well thought out and well crafted. They won't understand that the underlying motive is to be able to auction the D Block to enhance competition within the ranks of the commercial network operators. To accomplish that, they will have to short-change the public safety community once again.

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